Cohas Brook Bridge
State Highway #28 (South
Willow Street), 1.2 miles north of the
Londonderry/Manchester town line,
spanning the Cohas Brook
Manchester
Hillsborough County
New Hampshire

HAER No. NH-9

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
MID-ATLANTIC REGION NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
PHILADELPHIA, PENNSYLVANIA 19106

HISTORIC AMERICAN ENGINEERING RECORD

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Location: Cohas Brook Bridge
State Highway #28 (South Willow Street), 1.2 miles north of the Londonderry/Manchester town line, spanning the Cohas Brook
Manchester
Hillsborough County
New Hampshire

USGS Manchester South Quadrangle, Universal Transverse Mercator Coordinates: Zone 19
Easting: 3-01-500
Northing: 47-57-500

Date of Construction: 1929

Present Owner: City of Manchester, New Hampshire

Present Use: Highway crossing over Cohas Brook. The bridge is to be replaced by a contemporary structure to accommodate increased traffic loads. Projected date of demolition of the present bridge is 1986.

Significance: The Cohas Brook Bridge is significant as the first example of an open spandrel, reinforced concrete, parabolic arch bridge erected in New Hampshire, and one of only three, apparently, in the state. The structure is significant for its association with the designer, Harold E. Langley, an important bridge engineer with the New Hampshire Department of Public Works and Highways during the second quarter of the twentieth century; for its proximity to the site of several earlier crossings over the Cohas Brook; and for its association with the development of the city and state transportation network.

Project Information: Demolition of the Cohas Brook Bridge scheduled for 1986, funded by the Federal Highway Administration and New Hampshire Department of Public Works and Highways.

Project Information, continued:

Federal Highway Administration
Region 1, N.H. Division Office
Federal Building
55 Pleasant Street, Room 219
Concord, New Hampshire 03301

with

N. H. Department of Public Works and Highways
John O. Morton Building
Concord, New Hampshire 03301

Mitigative documentation prepared by:

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November 30, 1984

Transmitted by: Jean P. Yearby, HAER, 1985

Site and Bridge Description

The Cohas Brook Bridge is located in the city of Manchester, near the Merrimack River, in the southeastern portion of New Hampshire. The bridge is located approximately 3.5 miles south of Manchester's central business district.

The winding Cohas Brook is seven miles in length, running roughly east to west with a drop of about 125' from its origin in Lake Massabesic (elevation 251') to its outlet in the Merrimack River approximately 1.5 miles downsteam from the bridge.

Elevation of the bridge deck is 200'. The immediate site is sparsely developed and is approximately 1.2 miles north of the Londonderry town line.

The bridge, which is oriented on a north-south axis, crosses the Cohas Brook perpendicular to th stream channel. The banks of the stream have been altered where the bridge crosses it; extensive fill and rip-rap on the north bank conceal most of the principal abutment. The south bank was filled similarly and has a steep grade. The stream bed is 22' 11" below the crown of the arch rib intrados. The depth of the stream appeared to be no more than one to two feet in September of 1984; vegetation along the edge suggests that the stream rarely rises more than an additional two or three feet.

The banks of the brook are wooded. lmmediately southeast of the bridge, vegetation has been entirely removed where a new commercial storage warehouse is being built. Southwest of the bridge, Perimeter Road extends off Harvey Road through the industrial park to the Manchester Airport, the runways of which extend to less than a mile from the bridge.

The Cohas Brook Bridge, seen from an off-road vantage point upstream, presents an attractive, understated expression of structure and materials, effectively contrasting with the wooded borders of the stream. However, the usual view of the bridge, from the Highway #28 approaches, reveal only the simple paneled rails. To the traveling motorist, the bridge is not a visual landmark since its structure form is depressed within the stream channel.

The bridge is in excellent condition; minor spalling is evident on edges and corners of structural members. Some exfoliation of reinforced concrete deck railing has occurred. Bridge rating is H-15; the structure remains unposted.

General Dimensions of Structure

New Hampshire Department of Public Works and Highway Bridge Division files record 1929 as the year of construction of the Cohas Brook Bridge. The bridge was included under "Bridges Under Construction, December 15,, 1929" in New Hampshire Highways (7:9) and was listed among "Bridge Reconstructed in the Department's Annual Report for 1929/1930. The bridge structure bears no date or public dedication tablet.

Overall dimensions:

Overall bridge length	139' 8"
Main span length	61' 4"
Approach slab length	27' 8"
Approach slab length	26' 8"
Approach slab length	24' 0"
Bridge (outside) width	27' 4"
Bridge deck width	24' 0"
Finish graded to stream bed	29' 5"
Ribs:	
rise	16' 8-1/2"
spacing	20' 0" (center to center)
width	6' 0'
thickness at crown	1' 4"
thickness at spring	4' 6-1/8"
Deck slab thickness	8" at curb

The Cohas Brook Bridge is constructed upon two principal abutments. The twin arch ribs of the main span spring from concrete abutments measuring 12' 6" in height and 5' 6" in depth. These structures rest upon paired footings (buried) measuring 14' 0" by 11' 2-1/2" by 3' 6" in height. Fieldstone rip-rap is arranged to protect these structures below the spring line. A reinforced horizontal concrete shear panel connects each pair of abutment piers up to the base of the twin arch ribs. Reinforcing steel and concrete pass through and behind each abutment pier to distribute lateral thrust to the entire footing.

The four massive reinforced piers rised above the abutments, supporting the bridge deck at opposite ends of the main span.

The three approach spans are supported by two end bents and an intermediate bent (north). Depths of the rectangular footings vary; each is joined with a reinforced web or lateral brace above the footing.

Design Elements

The Cohas Brook Bridge is an open spandrel, twin parabolic arch bridge constructed with reinforced concrete. The north abutment of the main span and the piers and bents, all utilize open reinforcement; the south abutment is constructed simply with mass concrete. The wings are the butterfly type and also utilize reinforced concrete.

The reinforcing system of the Cohas Brook Bridge is probably not innovative, judging by its similarity to systems illustrated in several post-World War I manuals (interview with Howard Newlon, Research Council of the Virginia Department of Transportation and Highways). The system consists of a combination of square and round rods, bars, lines, and bands 1/2"-1" in thickness, concentrated in grids about 2" from the concrete surfaces. In the rib arches, pairs of hooked ties link the reinforcements of the intrados and the extrados every 12"; hook rods are employed at 18" intervals in the spandrel posts; V-stirrups are used in the base of the deck slab of the arched span.

The roadway originally consisted of a monolithic concrete wearing course utilizing 1/2" bituminous felt expansion joints. Sliding surfaces were interfaced with three plies of roofing felt. Curbings and the solid panel railing are of reinforced concrete. The roadway surface has been resurfaced with asphalt.

In its design, the Cohas Brook Bridge is firmly, though conservatively, rooted in the mainstresam of reinforced concrete arch bridge design as it evolved during the first three decades of the twentieth century. The Pont Adolphe Bridge at Luxenbourg (1903), a stone masonry arch, is cited by Elizabeth Mock (...Bridges, p. 88) as the European prototype for the twin-ribbed open spandrel, arched form. This bridge form, using the reinforced concrete system, made its first appearance in the United States before 1910, and it was widely used in the following two decades. The reinforced concrete, filled spandrel, barrel arch type continued to be built through the 1920s.

The twin-ribbed, open spandrel, reinforced concrete arch bridge is well-represented nationally, though not in New Hampshire. Carl Condit (American Building Art..., pp. 198-207) traces the evolution of this type from the 1906-08 Walnut Lane Bridge in Philadelphia through the next decades when more extensive arch rib reinforcement was employed. No systematic tabulation of this bridge type has yet been undertaken on a nationwide basis (interviews with Bruce Eberle, Federal Highway Administration), but the number is estimated to be in the hundreds, with concentrations in the midwest and far west.

New Hampshire Department of Public Works and Highways records and publications (Annual and Biennial Reports and New Hampshire Highways) and the 1982 "New Hampshire Historic Bridge Inventory (Sverdrup & Parcel and Associates, Inc.) reveals that earlier reinforced concrete arch highway bridges contained filled spandrel, barrel (rather than rib) arches. These were either minor spans with I-beam reinforcing, or were Luten arches with grids of reinforcing steel, built by the Luten Bridge Company in the wake of the November 1927 floods, which washed away many northern New Hampshire bridges.

The other examples of this bridge type in the state included the still extant Vilas Bridge (1930) (#062/052), designed by the New Hampshire Highway Department to span the Connecticut River between North Walpole, New Hampshire, and Bellows Falls, Vermont. The two arched spans measure 107' 6.75" overall. Only one other example, the 120', now altered arched span over the Sugar River in Newport (#085/101), erected in 1933, was identified in a search of Department files. In a telephone interview, Roger Blaisdell, retired long-time bridge inspector for the Department, could recall no other examples, although he suggested the possibility of private or railroad bridges not under the Department's jurisdiction.

The open spandrel, ribbed arch, reinforced concrete bridge type represented advantages over the filled spandrel arch bridge, depending on the rise of the arch, length of the span, and the nature of the bed for the piers. The open spandrel type afforded significant economy in the quantity of materials required, as well as in reduction of dead weight, factors discussed in such texts as J. A. L. Waddell's Economic of Bridge Work (pp. 222-223). The high cost of skilled labor required to build the forms for the arches, and the development of alternative combinations of steel and concrete, led to the decline of both types of concrete arches by the 1930s.

Increasingly sophisticateed reinforcing systems for all structural members resulted in designs which featured extremely slender arch ribs and spandrel bents, such as those found in California bridges of the 1920s and early 1930s (Condit, American Building Art..., pp. 198-207). The design of the Cohas Brook Bridge does not reflect this slenderness; it relies, more traditionally, on mass, although it achieves a balance of scale among the abutments, paired parabolic arch ribs, and the eight pairs of spandrel bents. There is a clear expresssion of the structural role of these forms, with no attempt to disguise the concrete as masonry.

The threes approach spans - reinforced concrete slabs - are borne on broad segmental arch spandrel beams between abutments; these are repeated on the main span with a tighter configuration between spandrel bents. These segmental arch spandrel beams are all reinforced, and, while serving a structural purpose, form a visual transition from the verticals of the spandrel bents above the arch ribs, to the horizontal deck slab.

Engineer/Designer

The designer of the Cohas Brook Bridge was Harold E. Langley, whose initials appear on the principal elevation drawing of the original plans of record (six sheets), filed with the Bridge Design Division, New Hampshire Department of Public Works and Highways, Concord, New Hampshire. Sheet #1, dated Auust 20, 1929, presents plans and elevation designs of the bridge, and was approved September 17, 1929, by John W. Childs, Bridge Engineer for the Department. No information about Harold E. Langley is on file at the Department. He has continued to live in Concord since his retirement in 1961. Mr. Langley declined to be interviewed.

In a brief, informal conversation in September 1984, Jane Cavanaugh, Langley's stepdaughter, noted that the engineer had designed all of the bridges spanning the Connecticut River. Confirmation of this statement was not possible. It is difficullt to determine the primary designers of major spans; plans of record typically bear the initials of several individuals within the Department and must be approved by the Bridge Engineer.

Records of the Registrar at the Massachusetts Institute of Technology disclosed that Harold E. Langley was enrolled as a Civil Engineering student in the class of 1919. He withdrew in 1917 during his second year, evidently without taking the highway and bridge design courses offered to third and fourth year students. Concord City Directories shows that Langley was a transit man for the New Hampshire Highway Department by the early 1920s; and by 1929, the year the Cohas Bridge was erected, he was "assistant engineer, State Highway Department." By 1940, he was designing engineer for the Department and, by 1943, had risen to hold the principal position of Bridge Engineer for the Bridge Division.

Langley does not appear to have been involved in the design of the reinforced concrete, open spandrel Vilas Bridge (1930) at North Walpole, New Hampshire/Bellows Falls, Vermont, or with the bridge over the Sugar River in Newport, New Hampshire. His initials do appear, however, on the drawings for the bridge at Stewartstown (1930), one of three steel arches spanning the Connecticut River. The Piscataqua River Bridge (#251/108) at Portsmouth, a 2,798' two-level Warren truss with a lift span, then the State's longest span and a major project for the Department, was built (1940) while Langley was designing engineer for the Bridge Division.

Like the Cohas Brook Bridge, these bridges were all evaluated in Sverdrup & Parcel's 1982 Historic Bridge Inventory as eligible for the National Register of Historic Places for the quality of their design and appropriate use of technology and materials.

Two of the steel bridges spanning the Connecticut River, each with a span of 425', were included in the 1943 edition of George Hoo]s and W. W. Kinne's textbook, Movable and Long Span Steel Bridges, for which Langley served as junior editor under R. R. Zipprodt (pp. 374 a-c). These structures, the Orford and Chesterfield Bridges, were each given the Award of Merit by the American Institute of Steel Construction for their respective years, as "Most Beautiful Steel Bridge, Class C."

The six sheets of the plans of records for the bridge are on file at the New Hampshire Department of Public Works and Highways, Bridge Design Division, Concord, New Hampshire. Photographic reproductions of the six sheets are included in the this report. These include:

Sheet 1: Upstream Elevation and Plan
Sheet 2: Downstream Elevation
Sheet 3: Details of Columns for Arch Span
Sheet 4: Details of Bents
Sheet 5: Slab and Girder Details
Sheet 6: Concrete Placement Diagram
Elevation Diagram

There is no evidence that the actual construction deviated from these designs.

Builder, Contractor, Suppliers

Files of the New Hampshire Department of Public Works and Highways Bridge Division record the Robie Construction Company of Manchester, New Hampshire, as contractor for the four spans of the Cohas Brook Bridge. New Hampshire Highways (7:9, December 1929) indicates that this company contracted to build the bridge at a cost of $28,648.00. There is no record of subcontracts for construction or supplies.

The president of the company in 1929 was William H. Lawes; he had been president of the New Hampshire Cement Construction Company, which merged with the Robie Consolidated Construction Company in 1924. A 1920 advertisement in the Manchester Directory for the New Hampshire Cement Construction Company announced reinforced concrete bridges as a specialty. No record could be found of New Hampshire Highway Department bridges constructed by either company prior to 1927, when Robie Construction was reported as contractor for a concrete filled arch bridge in Campton, New Hampshire (New Hampshire Highways, 5:3). The company was also contractor for the important reinforced concrete, open spandrel, arch rib Vilas Bridge (1930; #062/062) over the Connecticut River in North Walpole, New Hampshire, according to Department files.

An interview with William Eaton, vice president of the Robie Company, disclosed that the company records and photographs pertaining to the Cohas Brook Bridge and other structures for which the company contracted during that period were destroyed by fire in the early 1980s.

No alterations or additions to the reinforced concrete bridge structure are evident or recorded with the Department, although periodic resurfacing of the roadway and patching of spalled concrete areas as part of routine maintenance may be presumed.

Role of Bridge in Local and Regional Transportation Systems

The Cohas Brook was a significant natural feature which offered water-power and an abundant food supply; the earliest white settlement in Manchester was established along its banks by 1722. Saws and grist mills were established by settlers who had migrated northward from Massachusetts along the Merrimack

River. John B. Clarke (Manchester, p. 77) asserts that the first Manchester bridge "of any importance" spanned the Cohas as early as 1738, near the site of the present bridge.

Early nineteenth-century development of textile mills at the Amoskeag Falls on the Merrimack, several miles upstream, caused expanded development to shift away from the Cohas Brook.

The 1858 map of Hillsborough County (which includes Manchester), by J. C. Grace, Jr., shows a residential cluster near the roads which led south from the bridge crossing, with another concentration at the outlet into the Merrimack about one and one-half miles downstream. Farms bordered the road north into the rapidly developing city. Downstream or west of thee crossing was a pond, created as the impoundment for E. S. Harvey's lumber mill, bisected by the tracks of the Manchester and Lawrence Railroad. Several other Harveys (lumbermen and farmers) had houses along the present Harvey Road, which forks southwest off the main road, immediately south of the bridge. A single brick gable-roofed dwelling of Greek Revival style, now converted for offices is the only above ground nineteenth-century architectural resource surviving within the immediate environs of the bridge.

The Cohas Brook continued to serve as a significant source of waterpower through the early 1870s, when the city began drawing its water supply from Massabesic Lake, thus significantly altering the volume of flow. The Derry Mills, organized in 1865, built three mill structures on the falls near the mouth of the Cohas, and in 1873 employed 160 workers in the manufacture of woolen cassimeres, stockings, and shoddy (Clarke, Manchester, p. 305). Hurd's 1892 Atlas shows that both Harvey lumbermill and the textile operation at the mouth of the Cohas had been converted to steam power, and the Mill Pond breached (p. 49).

In the early years of the twentieth century, existing roads and bridges, built for draft animal traffic, began to be traversed by motor vehicles - which led to the development of a permanent, hard-surfaced, statewide roadway system. The Cohas Brook Bridge is representative of the technology, both in design and materials, of the structures which evolved in response to modern motorized transport.

A 1912 report on New Hampshire's highways, prepared by Fred Hoyt for the Office of Public Roads of the United States Department of Agriculture, shows that the present Highway #28 had not yet been designated a trunk line, but the Department's Biennial Reports for 1915/1916 and 1917/1918 record work on segments of the road, which was called the Rockingham Road Trunk Line. The work consisted of drainage improvements, resurfacing, and perhaps widening. The realignment and raising of the Cohas Brook crossing to its present configuration appears to have been done concurrently with construction of the existing bridge in 1929.

The record indicates, somewhat obliquely, that the previous bridge was replaced because of increased traffic. A 1927 report (U. S. Department of Agriculture, Bureau of Public Roads, ...Survey of Transportation on the State Highways of New Hampshire; map opposite p. 29) designated Highway #28 as an artery carrying "major" traffic loads - the highest traffic volume assigned in the report, which was based on 1926 traffic surveys. The highway then carried an average daily load of 1500 vehicles (map opposite p. 58).

The previous structure is described (but not illustrated) in Bridge Design Division files. It was a three-span bridge, 72' overall, consisting of I-beams with plank floor, and two concrete piers with a 24' roadway, the same width as the 1929 replacement bridge. The description of its design suggests that it was probably built near the turn of the century. Granite abutments which remain extant several rods downstream from (west of) the present bridge, and which are capped with concrete, identify the location of the earlier structure.

The present bridge was built on the eve of the Great Depression, during a period when Manchester was already experiencing the impact of the textile industry's exodus to the South. The construction of the bridge coincided with a period of expansion in state participation in highway and bridge building, made possible by growing revenues from licensing fees and gasoline taxes, and by the steady increase in federal highway funding to the states begun in 1916. State regulations prohibited state involvement in construction of bridge spans of more than ten feet (except by special legislation), until after the introduction of federal monies (Biennial Report, 1919/1920, p. 17). While many of the State's most important bridges were designed and/or built by out-of-state firms during this period, the Cohas Brook Bridge was designed by the Department and built by a Manchester firm - reflecting growing New Hampshire sophistication.

In the late twentieth century, replacement of the Cohas Brook Bridge has become necessary because of the increasing traffic volume and changing land use. No longer a principal interstate thoroughfare, this section of Highway #28 now serves as an extension of South Willow Street, which leads south out of Manchester and provides access for the recently-developed, sprawling Mall of New Hampshire on the outskirts of the city. A short distance away from the bridge, on Harvey Road, are the Manchester Airport and Grenier Field Industrial Park. Increased bridge width and capacity is necessary for safe, efficient travel for freight traffic destined for nearby Interstate 293.

According to Department records, ownership of the former Highway #28 bridge over the Cohas Brook was transferred from the city of Manchester to the State of New Hampshire in 1929, prior to the construction of the present bridge. Department records show that on May 1, 1974, the urban compact boundary line which separated the portion of Highway #28 owned and maintained by the city of Manchester from the section owned and maintained by the State of New Hampshire, was moved south from Huse Road in Manchester to the intersection of

Highway #28 and Harvey Road, immediately south of the bridge. This action transferred the bridge, in effect, to city ownership, although the actual conveyance of the title of the structure is not recorded in the Hillsborough County Registry of Deeds.

Sources of Information

A. Original Architectural Drawings:

New Hampshire Department of Public Works and Highways, Bridge Design Division, Concord, New Hampshire (copies attached)

B. Early Views: None located

C. Interviews:

Blaisdell, Roger, retired bridge inspector for the New Hampshire Department of Public Works and Highways. By telephone to Meredith, New Hampshire, October 11, 1984, by Jane M. Porter.

Cavanaugh, Jane, stepdaughter of Harold E. Langley, designer of the Cohas Brook Bridge. By telephone to Concord, New Hampshire, September 21, 1984, by Jane M. Porter.

Eaton, William, vice president of Robie Construction Company, Manchester, New Hampshire. By telephone, September 24, 1984, by Jane M. Porter.

Eberle, Bruce, Federal Highway Administration, Environmental Division, Washington, D. C. By telephone, October 24, 1984, by Jane M. Porter.

Newlon, Howard, Director of Research Council, Virginia Department of Transportation and Highways. By telephone to Alexandria, Virginia, October 24, 1984.

D. Bibliography:

1. Primary and unpublished sources:

Artemel, Janice G. (subconsultant for Sverdrup & Parcel and Associates). "Highway Bridges of New Hampshire: A Historic Overview." April 1983. (New Hampshire Department of Public Works and Highways, Bridge Design Division, Concord, New Hampshire)

New Hampshire Department of Public Works and Highways, Bridge Design Division, Concord, New Hampshire. Files. These include card files with construction data and photographs of New Hampshire bridges within the Department's jurisdiction, and files containing the design sheets for bridges built by or for the Department. Also consulted was the file related to Sverdrup & Parcel and Associates "New Hampshire Historic Bridge Inventory" [see below], containing working lists for New Hampshire bridges, both on- and off-system.

Sverdrup & Parcel and Associates, Inc. "New Hampshire Historic Bridge Inventory." 1982. Prepared for the New Hampshire Department of Public Works and Highways, this inventory consists of reports on 149 New Hampshire highway bridges. Inclusion of a bridge in the inventory represents a consensus as to historic merit by the consultants, the State Historic Preservation Officer, and the Department of Public Works and Highways. [New Hampshire Department of Public Works and Highways, Bridge Design Division, Concord, New Hampshire]

2. Secondary and published sources:

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Hoyt, Charles, C. E. New Hampshire Highways. Report (U. S. Department of Agriculture, Office of Public Roads, Bulletin #42). Washington, D. C.: Government Printing Office.

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Manchester [New Hampshire] City Directory. Publisher and frequency of publication varies. Consulted for years 1851-1855 and 1918-1932.

Mock, Elizabeth B., The Architecture of Bridges. New York: Museum of Modern Art, 1949. Discussion of reinforced concrete arch bridges, p. 88.

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New Hampshire. State Department of Highways. Biennal Report. 1905/1906 - 1919/1920.

New Hampshire Highways, vols. 3 - 9 (1925 - 1931).

Potter, C. E. The History of Manchester. Manchester, N.H.: C. E. Potter, 1856. [Manchester Historic Association, Manchester, N. H.] History of Cohas Brook, pp. 655-661.

Thorp, L. Ashton. Manchester of Yesterday. Manchester, N. H.: Granite State Press, 1939. Use of Lake Massabesic for Manchester water system, p. 494.

U. S. Department of Agriculture, Bureau of Public Roads. Report of a Survey of Transportation on the State Highways of New Hampshire. 1927.

Waddell, J. A. L. Economics of Bridge Work. New York: John Wiley & Sons, 1921.

Watson, Wilbur J. Bridge Architecture. New York: Wm. Helburn, Inc, 1927.

E. Likely Sources Not Yet Investigated: None known

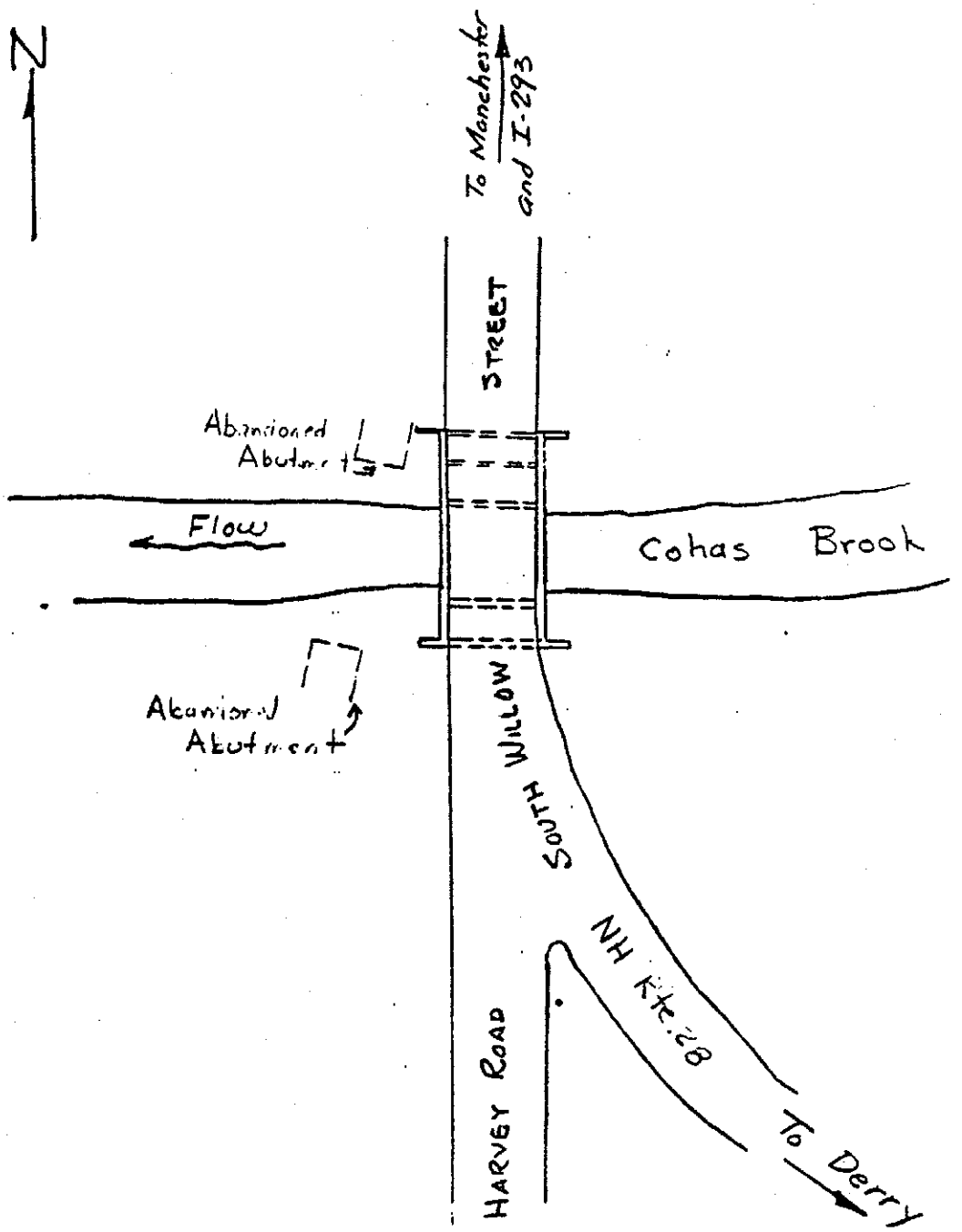
F. Supplemental Material: None

COHAS BROOK BRIDGE
HAER No. NH-9 (Page 14)

BRIDGE LOCATION
USGS MANCHESTER SOUTH QUADRANGLE

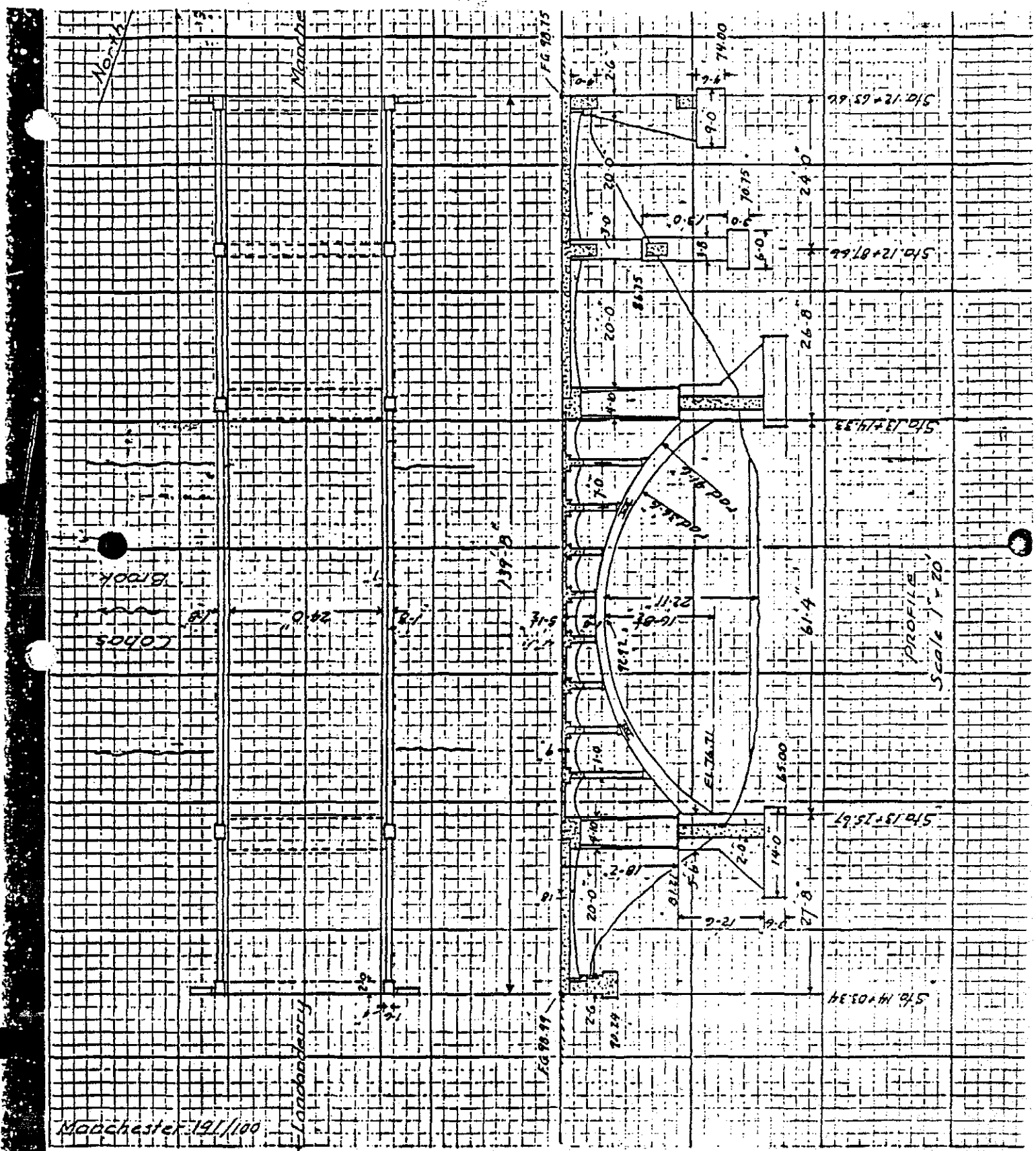
Site plan with north arrow

SKETCH SITE PLAN

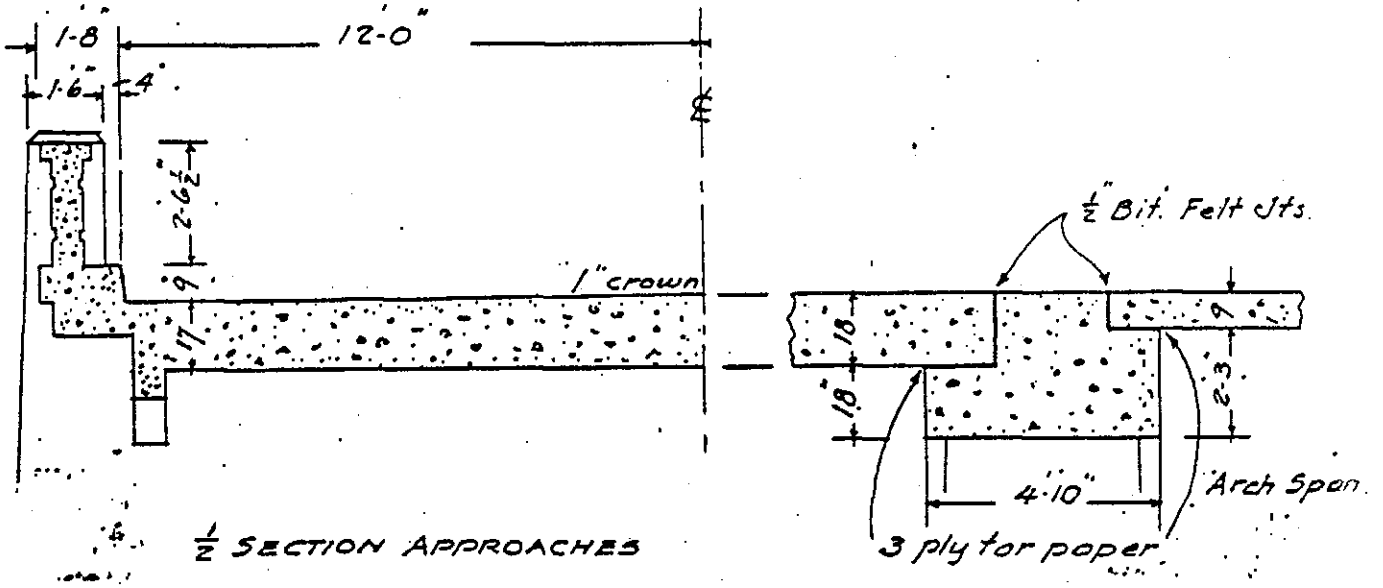


Manchester 191/100

UPSTREAM (EAST) ELEVATION



BRIDGE DECK SECTION DETAILS



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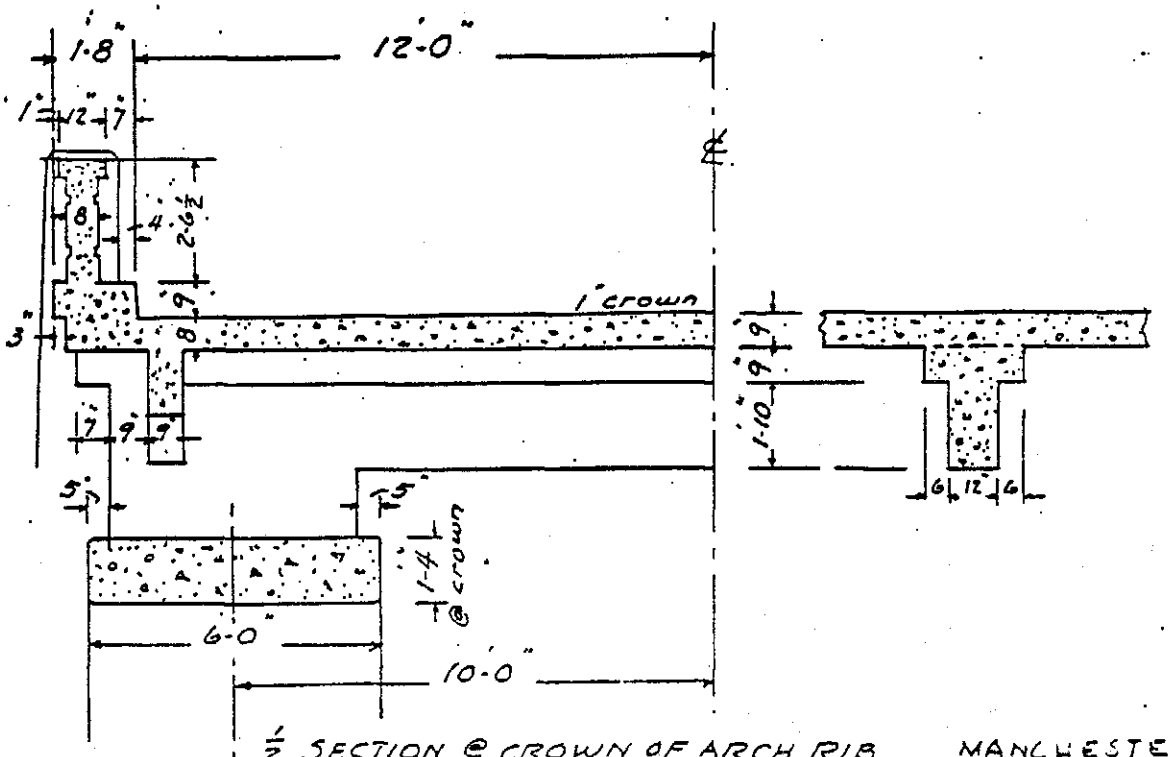
16



½ SECTION @ CROWN OF ARCH RIB
Scale ¼" = 1'-0"

MANCHESTER 191/166